Catastrophic cattle loss to low larkspur (*Delphinium nuttallianum*) in Idaho

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Low larkspur (*Delphinium nuttallianum* Pritz.) is a low-growing shallow-rooted perennial plant often implicated in livestock deaths during spring or summer. Death losses to low larkspur are usually sporadic with only a few animals poisoned in each episode. The toxins in low larkspur are diterpenoid alkaloids, with most of the toxicity attributed to methyllycaconitine (MLA) and nudicauline (Manners et al. 1995). Low larkspur contains other untested alkaloids that may play a role in mammalian toxicity (Gardner and Panter, unpublished data). The LD_{50} of MLA in mice is 4.5 mg/kg b.w. (i.v.) whereas the LD_{50} for nudicauline is about 2.5 mg/kg b.w. (Manners et al. 1995). We estimate that the LD_{50} of the toxic alkaloid fraction (MLA and related alkaloids) from oral ingestion in cattle is about 40 mg/kg b.w. (Pfister et al. 1994, Pfister et al. 1999). In practice, this amounts to about 3 kg of dry larkspur containing about 4 mg/g of MLA and nudicauline.

Low larkspurs generally grow on foothill or mountain ranges, and often initiate growth before other forage species. It takes about 3-7 years for low larkspur to flower for the first time (Waser and Price 1991), and each individual plant produces only one inflorescence (Waser and Price 1981). Availability of low larkspurs is often cyclic, as plant density and seasonal longevity are influenced by precipitation patterns and temperature (Majak and Engelsjord 1988, Saavedra

2000). Inouye and McGuire (1991) have shown that timing and abundance of flowering in low larkspurs depends on winter snowpack. Thus, low larkspur populations likely increase in response to cold, wet winter and spring climatic conditions.

CASE REPORT

Case History

Four hundred and four cattle (cow-calf pairs and bulls) grazed a 7986 acre pasture near Richfield, Idaho (Lincoln County 43^0 10' 01" N 114^0 09' 22" W; elevation 4000 ft.). The pasture was native sagebrush range with big sagebrush (*Artemisia tridentata*), cheatgrass (*Bromus tectorum*), bluegrass (*Poa* spp.), and low larkspur (*Delphinium nuttallianum*). The cattle were placed on the pasture on April xx, 2002. During mid-May (about May 14-16) 49 cows and 4 bulls were fatally poisoned by low larkspur. Low larkspur had recently begun to flower when cattle began eating large amounts of the plant, as evidenced by the many grazed plants. Necropsies of dead animals were not done and no blood or tissue samples were collected for diagnostic examination. Surviving cattle were moved to a new pasture and no further losses were reported.

Another incidence of larkspur losses in southern Idaho was reported to us about 1 month after the actual event. Forty-three cows were killed in a herd of 450 cattle about April 22. The cattle were grazing a 2000 acre pasture 30 miles south of Mountain Home, ID (approximately 42^0 35' N 116^0 00' W). The rancher reported that he typically loses 2 or 3 animals each year to low larkspur in this location, but that the larkspur was unusually dense during April, 2002. The larkspur was in the bud stage, and thirty head died in one day after the animals began to eat the plant. Thirteen other animals died overnight after being moved out of the pasture, and no losses occurred thereafter. The area reportedly had ample winter and spring moisture and the weather

was cool. The native grasses were green but less available than the larkspur when the losses occurred, and much of the larkspur was grazed.

Weather records

The National Climate Data Center web site was queried to determine precipitation and temperature monthly means (1971-2000), and to determine temperatures and precipitation during winter, 2001 and spring 2002 . Data were available up to and including March, 2002 for Shoshone, ID, approximately 20 mi from the Richfield, ID pasture.

Alkaloid analysis of larkspur

The low larkspur in the pasture was identified by an experienced observer as *Delphinium nuttallianum*. Numerous samples of low larkspur were collected on May 20 throughout the pasture, and composited into a single sample. This frozen sample was freeze dried, ground to pass a 1-mm screen, then analyzed for diterpenoid alkaloids by electrospray mass spectroscopy (Gardner et al. 1999).

Alkaloid concentrations in larkspur samples

Discussion

This report details one of the largest single losses of cattle to low larkspur ever reported to our laboratory. Several factors were involved in inducing such a loss. First, climatic conditions in the local area were ideal for low larkspur growth. The months of December, January, and March were wetter and cooler than normal (Table 1). Bureau of Land Management (BLM) records also indicate that April was cooler and wetter than normal. The density of low larkspur is higher when winter snowpack is above normal and ambient temperatures are below normal (Saavedra 2000). We estimate that the numerous low larkspur patches within the pasture

had densities of 10-20 plants/m^2. Our grazing studies suggest that low larkspur densities > 5 plants/m^2 increase the availability of low larkspur and the risk of cattle grazing the plant (Pfister and Gardner 1999).

Second, conditions for growing grass (particularly cheatgrass, the dominant spring forage for cattle) were poor. In spite of the winter moisture the pasture received, the cold temperatures probably retarded the growth of cheatgrass. Furthermore, anecdotal evidence suggests that a combination of killing frost and desiccating winds in late April and early May also severely retarded grass growth. In mid-May, cheatgrass was very short (1-2 in. tall) and turning brown.

Finally, a large number of cattle (> 20 animals) died while being moved out of the rugged pasture by ranch hands on horseback. The larkspur alkaloids effectively fatigue and paralyze the muscles of the legs and diaphragm (Dobelis et al. 1999), and the exertion of moving the animals also contributed to the death loss. The cholinergic drug physostigmine is an effective antidote to larkspur poisoning (Pfister et al. 1994), and the use of physostigmine injections for cattle that were recumbent likely would have reduced losses. It must be noted, however, that physostigmine is not approved for use in cattle, and repeated injections may be necessary because the inhibition of acetylcholinesterase at the neuromuscular junction lasts for only several hours. There is a risk in using physostigmine that intoxicated animals will become ambulatory for a period of time, then later be fatally intoxicated after they become fatigued from moving about.

It is important for livestock owners and managers to recognize toxic plants growing in their area. If there is an unusual abundance of larkspur or other toxic plants, then correct identification can provoke caution in grazing management. Larkspurs are palatable and nutritious forage (Pfister et al. 1999), and cattle will generally graze low larkspurs in proportion

to their availability (Pfister and Gardner 1999). In this case, abundant low larkspurs were a major source of green forage, particularly compared to the stunted grasses. In hindsight, it is easy to say that the cattle either should not have been placed into the pasture to graze, or should have been quickly removed when the initial deaths occurred.

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Table 1. Monthly mean temperature (F) and precipitation (in.) for Shoshone, Idaho during 2001-2002. Long-term averages were recorded from 1971 to 2000.

Month	Precip.	Long-term Average	Temp.	Long-term Average
2001				
Jan.	0.41	1.38	24.2	25.2
Feb.	0.44	1.11	28.3	30.6
Mar.	0.72	1.26	43.5	39.3
Apr.	1.57	0.69	45.5	47.9
May	0.27	.95	60.3	56.8
Jun.	0.10	.59	64.9	65.9
Jul.	0.60	.26	72.6	73.7
Aug.	0.0	.31	75.4	72.7
Sep.	0.32	.57	64.3	62.0
Oct.	0.42	.65	51.2	50.0
Nov.	1.16	1.28	41.0	35.8
Dec.	2.87	1.20	22.4	26.6
2002				
Jan.	1.44	1.38	24.8	25.2
Feb.	0.09	1.11	23.8	30.6
Mar.	1.49	1.26	35.0	39.3

Data taken from Internet site: www1.ncdc.noaa.gov